

Influence of Resin-Asphaltene Substances (RAS) Nanoparticles on the Activity of the Process of Catalytic Treatment of Oil Fractions from Oil and Oil-Saturated Lands with Olefins

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Abstract— This thesis presents the results of studies on obtaining high-index oils with high yield by catalytic treatment of the organic part isolated from oil-saturated lands of Azerbaijan with α -olefins. It is shown that carrying out the process with the organic part of oil-saturated lands in comparison with distillate from oil leads to higher yields of high-index oils, since along with the acid catalyst, the co-catalyst of the process in this case is resinous-asphaltene substances of the organic part of oil-saturated lands dispersed to nano-size. Micrographs of dry residues of resinous-asphaltene substances (RAS) isolated from the distillate and the organic part of oil-saturated lands, the dry residue of RAS dispersed with a solvent and its diffractogram are also presented.

Keywords— *oil-saturated lands, nano-size, resinous-asphaltene substances, high-index oils, micrograph*

I. INTRODUCTION

Growing energy consumption and high oil prices require the search for new sources of hydrocarbons. Such sources are oil-saturated lands. Hydrocarbons are extracted from oil-saturated lands mainly by thermal processes with the production of gasoil and naphtha [1, 2], but there is no information on the production of lubricating oils. At the same time, methods are known for obtaining high-index oils from Azerbaijan oils by combining selective purification and hydrotreatment [3].

WE isolated the organic part from the bituminous sands of Azerbaijan, which was characterized by a density at 20 °C of 928-1142 kg/m³, a kinematic viscosity at 100 °C of 8.8-9.5 mm²/s, viscosity index 25-56, beginning of boiling 266-268 °C, up to 350 °C – 28.8-30 %, a naphthene-paraffin content of 10-12 %, aromatic hydrocarbons 88-90 %, including 9-10 % resins.

II. PROBLEM STATEMENT AND THE MAIN PART

Our recent studies [4-5] have shown that base oils can be obtained by treating distillate oil fractions of low-paraffin oils and the organic part isolated from oil-saturated lands of Azerbaijan (Girmaki, Mashtaga, etc.) with olefins in the presence of acid catalysts. However, in the case of using the organic part of oil-saturated lands, the obtained oils significantly exceed the yields and viscosity index of oils obtained from low-paraffin oils, which is confirmed by the data in Table 1.

TABLE 1. COMPARATIVE CHARACTERISTICS OF THE YIELD AND QUALITY OF OILS OBTAINED BY CATALYTIC TREATMENT WITH OLEFINS OF THE ORGANIC PART OF OIL-SATURATED LANDS AND THE OIL FRACTION FROM LOW-PARAFFIN OILS

Names of the indicators	Oil based on:	
	<i>the oil fraction 350-500 °C from low-paraffin oils</i>	<i>the organic part of the fraction 260-500 °C and higher from oil-saturated lands</i>
Oil fraction yield >350 °C, % per process	54-72	90-92.7
Kinematic viscosity at 100 °C, mm ² /s	6.3-7.8	14.5-57.7
Viscosity index	95-100	110-115

The data in the table show that the oil obtained by catalytic treatment of the organic part of oil-saturated land with α -olefins significantly exceeds the oil from the distillate of oil with a boiling range of 350-500 °C in terms of yield of 90-92.7% and viscosity index (110-115). In order to explain the noticeable difference in the results, we isolated the solid component (SAC) contained both in the distillate of low-paraffin oils and in the organic part of oil-saturated lands. The literature contains information on methods for isolating ultra-fine particles used in modern oil refining and petrochemistry [6]. We also used physical methods for isolating SAC with subsequent identification by X-ray diffraction and

microscopy. The distillate and organic part were treated with heptane, then the resulting solution was separated by filtration, the mass remaining on the filter was treated with alcohol-benzene, the resulting filtrate containing resinous-asphaltene substances (RAS) was dried. Fig. 1 and 2 show microphotographs of dry residues of RAS isolated from the distillate and organic part of oil-saturated lands. Particles aggregated to tens of microns and not very different from each other in appearance behave completely differently in organic solvents.

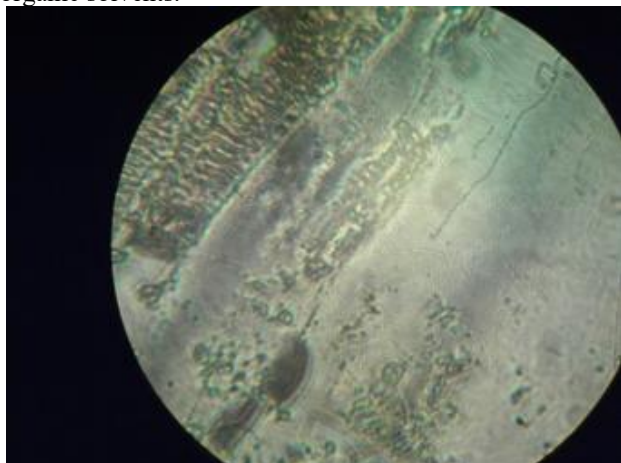


Fig. 1. Micrograph of the dry residue of the organic part of the ras of oil-saturated lands

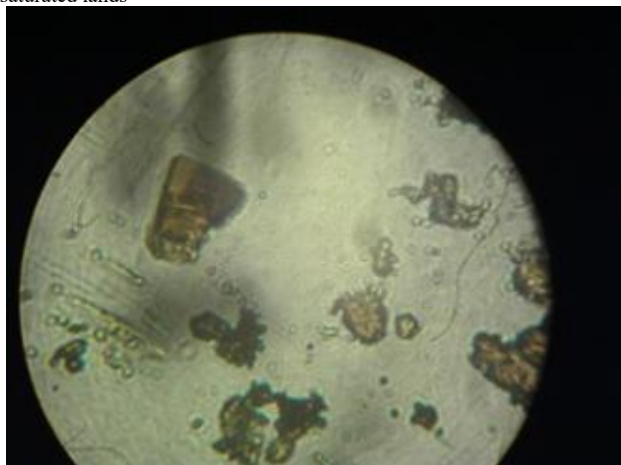


Fig. 2. Micrograph of dry residue of low-paraffin oils

If the aggregates from the distillate practically do not disintegrate into smaller components, then the dissolution of aggregated clusters from the organic part of oil-saturated lands, both in various solvents and in light fractions of the oil itself, leads to strong dispersion of the aggregates into a well-homogenized mass consisting of many microparticles. Fig. 3 shows a micrograph of the solvent-dispersed dry residue of the organic part of oil-saturated lands. As can be seen from this figure, particles from 1 to 5 μm in size are clearly distinguishable in the micrograph; the main mass of the substance is made up of particles of about 1.5-2.5 μm in size. Considering the limitations of the organic microscope, which does not allow one to examine smaller particles and wanting to clarify the nature of the dry residue, its X-ray phase analysis was carried out.

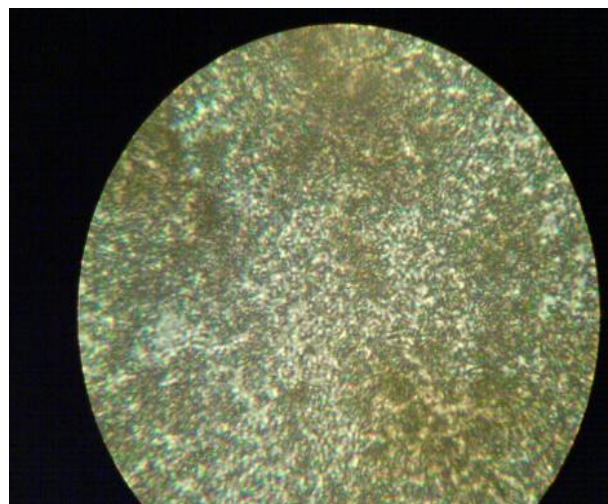


Fig. 3. Micrograph of the solvent-dispersed dry residue of the organic part of oil-saturated land.



Fig. 4. Micrograph of dispersed residue of ras from low-paraffin oils

Fig. 5 shows the diffractogram of the RAS of the organic part of oil-saturated lands. The given diffractogram characterizes a highly carbonized substance and is very reminiscent of the halo obtained in the X-ray diffraction patterns of high-carbon products.

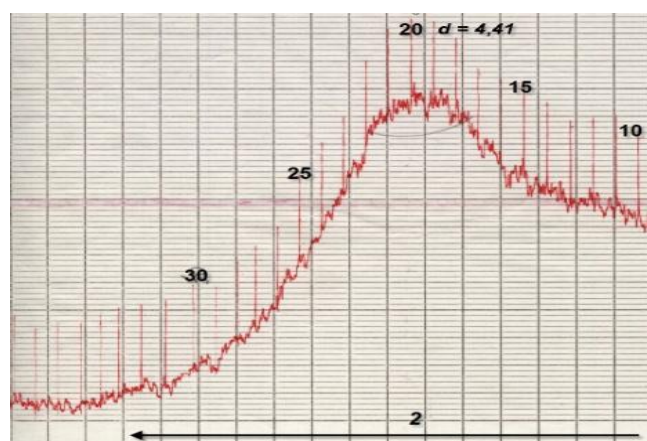


FIG. 5. DIFFRACTION PATTERN OF THE RAS ORGANIC PART OF OIL-SATURATED LAND

The sizes of microcrystals calculated from the diffraction pattern using the Scherer equation [7] showed that the

particles in the large halo consist on average of crystals of about 1 nm, and at the top – of particles of about 2-2.5 nm. Since the catalytic treatment of the organic part with α -olefins after purification from RAS or distillate of low-paraffin oils, where, as indicated above, there are also no highly dispersible RAS, does not lead to high yields of high-index oils, it can be said with confidence that along with the acid catalyst, the co-catalyst of the process is RAS of the organic part of oil-saturated lands dispersible to nano-size.

III. CONCLUSION

The results of X-ray analysis of the sample of oil-saturated land of the Girmaki field showed that the sample consists of α -quartz and mordenite ($\text{Al}_2\text{Si}_{10}\text{O}_{24}\cdot 7\text{H}_2\text{O}$).

Thus, it was shown that the presence of small crystals with sizes from tens to 1000 nm in the resinous-asphaltene organic part of oil-saturated lands (nanoparticles) significantly affects the catalytic process and allows to significantly intensify the production of high-index oil, since the RAS from the organic part of oil-saturated lands are subject to oxidative condensation in the presence of land, which is proven by the size and activity of the nanoparticles.

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